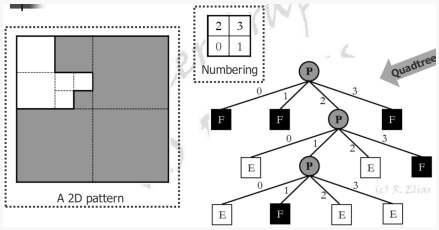
Wireframe Models

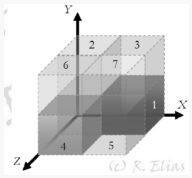
In a wireframe model, only vertices and edges are represented. No face information is available with this model. A wireframe model can be represented using two tables: Vertex table where each entry is a vertex number and its coordinates. Edge table where each entry is an edge number, start & end vertices.

Easy to construct, modify, clip and transform. Best choice for previewing models since less information processes faster.
Could be ambiguous sometimes and could result in different interp-retations. Sometimes, using wireframes might result in unrealistic models.

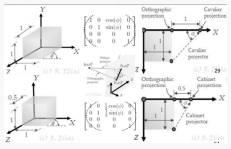
Quadtrees



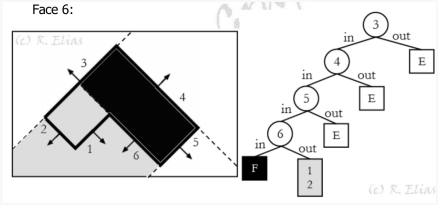
Octrees



Oblique Projections



BSP Trees



A binary space partitioning (BSP) tree splits the space by surfaces of the solid being represented (i.e., as the dividing planes). A dividing plane splits the space into two sub-spaces representing two children; in front and in back of this plane (determined by the normal to the plane). The process is repeated recursively for each sub-space. It stops when the sub-space is entirely “in” or “out” the solid.

Sweep Representations

Translational sweeps: (Extrusion) Sweeping an object along a path creates a translational sweep . **Rotational sweeps**: (Revolution) Sweeping or revolving an object about an axis creates a rotational sweep.

Boundary representations

Edge	Vertices		Faces		Left traverse		Right traverse	
Name	Start	End	Left	Right	Pred	Succ	Pred	Succ
1	a	b	B	A	5	4	3	2

Used to avoid the source of ambiguity arising in wireframe. For each edge we need the following info: Vertices of this edge. Its left and right faces. The predecessor and successor of this edge when traversing its left face. The predecessor and successor of this edge when traversing its right face. Two more tables: The vertex table contains one entry for each vertex that represents an edge passing through it. The face table contains one entry for each face that represents one of its edges.



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1P Perspective



COP@Origin, z=d

COP@[0,0,-d], z = 0

The view plane intersects the z -axis. The normal to the view plane is parallel to the z -axis. Two components of the view plane normal n are zeros. Lines parallel to the view plane will be orthographically projected as a multi-view projection. Lines parallel to the 3 rd axis (which is parallel to the view plane
normal) converge to a single vanishing point.

Interior, Exterior and Closure

The **interior** of a solid contains all points inside the solid. The **closure** of a solid contains the interior points plus the points on the surface of the solid. The **exterior** of a solid contains points that do not belong to the closure.

Spatial Enumeration

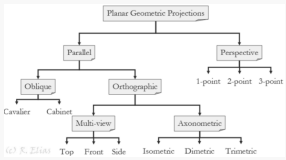
In spatial enumeration, the space is split into equal-sized small volume elements or **voxels** . A voxel may be vacant or occupied. Any 3D model can be represented as a list of occupied voxels.

Rotation/Shearing (h)

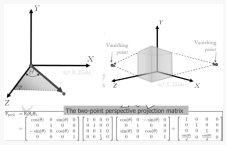


xyz

Planar Projections

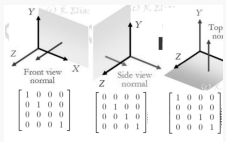


2P Perspective



When the center of projection is at the origin and the normal to the view plane makes an angle θ with the yz-plane: the overall two-point perspective projection process can be achieved in three steps.
1. Rotate through an angle −θ about the y -axis so that the normal to the view plane coincides with the z -axis. 2. Perform a one-point perspective projection. 3. Rotate back through an angle θ about the y -axis.

Multi-view Projections



Polygonal Modeling

Independent faces: each face is indicated as a sequence of vertex coordinates. **Vertex and face tables**: uses two tables; *Vertex table*: showing vertex numbers and coordinates and *Face table*: showing faces and their surrounding vertex numbers. **Adjacency lists**: A face is associated with three lists of adjacent vertices, edges and faces. An edge is ... A vertex is ... Efficient way for traversal at the cost of more storage space. **Triangle meshes**: Only triangular faces are considered. A vertex may be shared among many faces. For each face, surrounding vertices and adjacent faces are stored..

A group of adjacent faces comprises what is called a polygonal mesh.

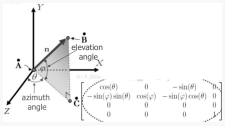
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Translation/Scaling (h)

$$\begin{bmatrix} 1 & 0 & 0 & tx \\ 0 & 1 & 0 & ty \\ 0 & 0 & 1 & tz \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} Sx & 0 & 0 & 0 \\ 0 & Sy & 0 & 0 \\ 0 & 0 & Sz & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

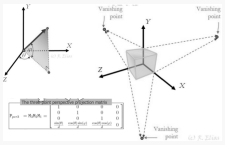
3D Reflection xy-plane: 3D scaling (1,1,-1) yz: (-1,1,1) xz: (1,-1,1)

Axonometric Projection



1. Rotate through an angle −θ about the y -axis. 2. Rotate through an angle φ about the x -axis. 3. Use the front view projection matrix

3P Perspective



When the center of projection is at the origin and the normal to the view plane
makes an angle θ with the yz-plane and an angle φ with the zx -plane, the overall three-point perspective projection process can be achieved in three steps. 1. Rotate through an angle φ about the x -axis so that the normal to the view plane coincides with the zx -plane. 2. Perform a two-point perspective projection. 3. Rotate back through an angle −φ about the x -axis.

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